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Assistant Commissioner for Patents  
Box PATENT APPLICATION  
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Sir:

Transmitted herewith for filing is the patent application of  
Inventor(s): ITO, Wataru

For: METHOD, APPARATUS AND RECORDING MEDIUM FOR IMAGE PROCESSING

Enclosed are:

- A specification consisting of 12 pages
- 3 sheet(s) of Formal drawings
- An assignment of the invention
- Certified copy of Priority Document(s)
- Executed Declaration     Original     Photocopy
- A verified statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27
- Preliminary Amendment
- Information Disclosure Statement, PTO-1449 and reference(s)

Other

The filing fee has been calculated as shown below:

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<b>BASIC FEE</b>	***** ***** *****	***** ***** *****	***** ***** *****	\$690.00 or	**** **** ****	\$345.00 or
<b>TOTAL CLAIMS</b>	3 - 20 =	0	x18 = \$ 0.00	or	x 9 = \$ 0.00	or
<b>INDEPENDENT</b>	3 - 3 =	0	x78 = \$ 0.00	or	x 39 = \$ 0.00	or
MULTIPLE DEPENDENT CLAIM PRESENTED	no		+260 = \$ 0.00	or	+130 = \$ 0.00	or
			TOTAL \$ 690.00		TOTAL \$ 0.00	

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Respectfully submitted,

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METHOD, APPARATUS AND RECORDING MEDIUM FOR IMAGE PROCESSING

BACKGROUND OF THE INVENTION

Filed of the Invention

5       The present invention relates to an image processing method and an image processing apparatus for carrying out image processing on an image including a figure, and also to a computer-readable recording medium storing a program to cause a computer to execute the image processing method.

Description of the Related Art

10     When a portrait is viewed, most attention is paid to the face of the person therein. In order to generate a high-quality photograph, the color and/or density of the face of a figure in the photograph needs to be corrected. Therefore, a method of generating a portrait having appropriate color and/or density of the face of a figure therein has been proposed (see Japanese Unexamined Patent Publication No. 6(1994)-67320, for example).

15     In this method, a candidate area for a face is extracted by dividing a portrait based on distributions of hue and chroma values of the portrait and a face area is extracted based on a shape of an area positioned close to the candidate area. By determining exposure of a photosensitive material based on color and/or density of the face area, color and density of the face of the person become appropriate. Another method of generating a photograph including a figure whose face has appropriate color

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and/or density has also been proposed (see Japanese Unexamined Patent Publication No. 8(1996)-110603). In this method, a face area of a figure is extracted from a photograph generated in uneven lighting due to shade or a flash, and exposure is determined by removing the illumination variance from the face area. In this manner, each face has appropriate color and/or density in the photograph.

However, in recognition of color and density of a target area, it has been known that human vision is affected by color and density of areas surrounding the target area (Color Appearance Model, M. D. Fairchild, ADDISON-WESLEY, 1998). In other words, when surroundings are dark, an object therein looks light, while the object looks dark when the surroundings are light, even if the density of the object is actually the same in both cases. For example, when two areas having the same gray density are viewed in equal-density backgrounds, the two areas are perceived to have the same density. However, when the same areas are viewed on black and white backgrounds respectively, the density is perceived to be different between the two areas.

Therefore, even if the processing for appropriately correcting color and density of the face area is carried out as described in Japanese Unexamined Patent Publication Nos. 6(1994)-67320 and 8(1996)-110603, the color and the density of the face area may not become appropriate due to the effect caused by color and density of areas surrounding the face area.

SUMMARY OF THE INVENTION

The present invention has been conceived based on consideration of the above problems. An object of the present invention is to provide an image processing method and an image processing apparatus for carrying out image processing causing color and/or density of the face of a person to become appropriate without being affected by the surroundings, and also to provide a computer-readable recording medium storing a program to cause a computer to execute the image processing method.

An image processing method of the present invention is a method of carrying out image processing on an image including a figure, and the image processing method comprises the steps of:

extracting a face area of the figure from the image; and  
adjusting density and/or color of the face area based on density information and/or color information of an area surrounding the face area.

As a method of "extracting the face area", not only the methods described in Japanese Unexamined Patent Publication Nos. 6(1994)-67320 and 8(1996)-110603 but also a method of manual extraction of a face area by an operator using a light pen and a method of extracting a face area by using a neural network described in Japanese Unexamined Patent Publication No. 5(1993)-274438 or 5(1993)-307605 may be used, for example.

An image processing apparatus of the present invention is

an apparatus for carrying out image processing on an image including a figure, and the image processing apparatus comprises:

face area extracting means for extracting a face area of  
5 the figure from the image; and

adjusting means for adjusting density and/or color of the face area based on density information and/or color information of an area surrounding the face area.

The image processing method of the present invention may be provided as a program recorded in a computer-readable recording medium to cause a computer to execute the processing.

According to the present invention, since the density and/or the color of the face area is adjusted by using the density and/or color information of the surrounding area, the density and/or the color of the face area can be perceived appropriately without being affected by the density and the color of the surrounding area.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram showing an outline configuration of an image processing apparatus according to an embodiment of the present invention;

Figure 2 is a diagram for explaining detection of color and/or density of an area surrounding a face area (part 1);

Figure 3 is a diagram for explaining detection of the color and/or density of the surrounding area (part 2);

Figure 4 is a graph showing a function used in an operation for adjusting density; and

Figure 5 is a flow chart showing an operation of the embodiment.

5                   DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, an embodiment of the present invention will be explained with reference to the accompanying drawings.

Figure 1 is a block diagram showing an outline configuration of an image processing apparatus according to the embodiment of the present invention. As shown in Figure 1, an image processing apparatus 1 according to this embodiment is for carrying out processing on image data S0 representing an image including a figure obtained by image generating means 2 such as a digital camera or a scanner. The image processing apparatus 1 comprises face area extracting means 3 for extracting a face area A1 of the figure from the image represented by the image data S0, surrounding color density detecting means 4 for detecting color and/or density (hereinafter called color density) of an area surrounding the face area A1 as color density information H, and adjusting means 5 for obtaining processed image data S2 by carrying out processing for adjusting color density on image data S1 representing the face area A1 extracted by the face area extracting means 3, based on the color density information H of the area surrounding the face area A1 detected by the surrounding color density detecting means 4. The

DETAILED DESCRIPTION

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processed image data S2 are output by output means 6 such as a printer or a monitor.

In the face area extracting means 3, the face area is extracted by using a conventional method. As this method, the methods described in Japanese Unexamined Patent Publication Nos. 6(1994)-67320 and 8(1996)-110603, or the method of manual extraction of the face area by an operator using a light pen, or the method of extracting the face area by using the neural network described in Japanese Unexamined Patent Publication No. 5(1993)-274438 or 5(1993)-307605 can be used, for example.

The surrounding color density detecting means 4 determines the area surrounding the face area A1 extracted by the face area extracting means 3, and calculates an average density of pixels in the surrounding area as the color density information H. More specifically, for example, in the case where the face area A1 is extracted as a circular area shown in Figure 2, a concentric area excluding the face area A1 and having a radius 3r, which is 3 times a radius r of the face area A1, is set as a surrounding area A2. The average density of the surrounding area A2 is calculated as the color density information H. When the average is calculated, it is preferable for any pixels having high saturation to be excluded. Furthermore, as shown in Figure 3, the surrounding area A2 may be divided into eight areas so that a median of averages of the density of pixels in the eight areas is calculated. In this manner, fluctuation of the density of

the surrounding area A2 caused by a minute high-saturation area  
is prevented. Moreover, the surrounding color density area  
detecting means 4 may find color of the surrounding area A2 and  
include information regarding the color in the color density  
information H.

The adjusting means 5 adjusts density of the face image  
data S1 representing the face area A1, based on the color density  
information H of the surrounding area A2 found by the surrounding  
color density detecting means 4. For example, when the density  
of the surrounding area A2, which is the average found in the  
above manner, is Q and when the density of the face area A1 is  
K, a signal value of each pixel in the face area A1 is adjusted  
according to the following equation (1):

$$K_{\text{new}} = K + \beta(Q-K) \quad (1)$$

In Equation (1),  $K_{\text{new}}$  is a pixel value after the processing,  
and  $\beta$  is a table as shown in Figure 4. By carrying out an  
operation shown by Equation (1), the density of the face area  
A1 is corrected to become higher if the density of the surrounding  
area is higher than the density of A1. If the density of the  
surrounding area is lower than the density of the face area A1,  
the density of the face area A1 is lowered. In the above equation,  
 $\beta$  may be a constant. Furthermore, the signal value of each  
pixel in the face area A1 may be corrected according to the  
following equation (2):

$$K_{\text{new}} = K + \alpha \cdot \beta(Q-K) \quad (2)$$

In Equation (2),  $\alpha$  is a function whose value changes in accordance with the color of the face area A1. The closer to skin color the hue of the pixel having the value K becomes in a chromaticity diagram, the closer to 1 the value  $\alpha$  becomes.

5 The value  $\alpha$  becomes closer to 0 the more the hue is different from the skin color. In this manner, even in the case where the face area A1 is extracted as an area including not only a skin-color portion but also hair or the like, the density of the skin-color area is corrected substantially in the face area A1. Therefore, the density is not changed unnaturally at a border of the face area A1.

In the adjusting means 5, the density of the face area A1 may be corrected by using not only Equations (1) and (2) but also a table showing a relationship between  $K_{new}$  and Q-K generated in advance. In the case where the density information H includes information regarding color of the surrounding area A2, the color of the face area A1 may be corrected based on the color of the surrounding area A2. For example, when the surrounding area A2 is blue, the complexion looks pale since the color of the face area A1 is perceived to be bluish. Therefore, it is preferable for the color of the face area A1 to be converted into a reddish color. Furthermore, only the color of the face area A1 may be corrected based on the color of the surrounding area A2, by letting the color density information H be information regarding color only.

An operation of the present invention will be explained next. Figure 5 is a flow chart showing the operation of this embodiment. The image data S0 generated by the image generating means 2 are input to the image processing apparatus 1 (Step 1).

5 In the image processing apparatus 1, the face area extracting means 3 extracts the face area A1 of a figure (Step S2). The image data representing the face area A1 are the image data S1. The surrounding color density detecting means 4 detects the color density information H of the area surrounding the face area A1 (Step S3). Based on the color density information H, the adjusting means 5 adjusts the color density of the face area A1 as has been described above, and the processed image data S2 are obtained (Step S4). The processed image data S2 are output by the output means 6 (Step S5).

15 As has been described above, according to this embodiment, the color density of the face area A1 is corrected based on the color density of the area surrounding the face area A1. Therefore, the face area A1 can be corrected to have appropriate color density, without being affected by the color density of 20 the surrounding area.

In the above embodiment, the processing is carried out on the image data S0 obtained by the image generating means 2. However, the processing may be carried out on an image having been corrected to have appropriate density of the face area A1 25 according to the method described in Japanese Unexamined Patent

Publication No. 6(1994)-67320 or 8(1996)-110603. In this case, face area extracting means of an apparatus for carrying out the above method can be used as the face area extracting means of the present invention.

What is claimed is:

1. An image processing method for carrying out image processing on an image including a figure, the image processing method comprising the steps of:

5 extracting a face area of the figure from the image; and  
adjusting density and/or color of the face area based on density information and/or color information of an area surrounding the face area.

2. An image processing apparatus for carrying out image processing on an image including a figure, the image processing apparatus comprising:

face area extracting means for extracting a face area of the figure from the image; and

adjusting means for adjusting density and/or color of the face area, based on density information and/or color information of an area surrounding the face area.

3. A computer-readable recording medium storing a program to cause a computer to execute a method of carrying out image processing on an image including a figure, the program comprising the procedures of:

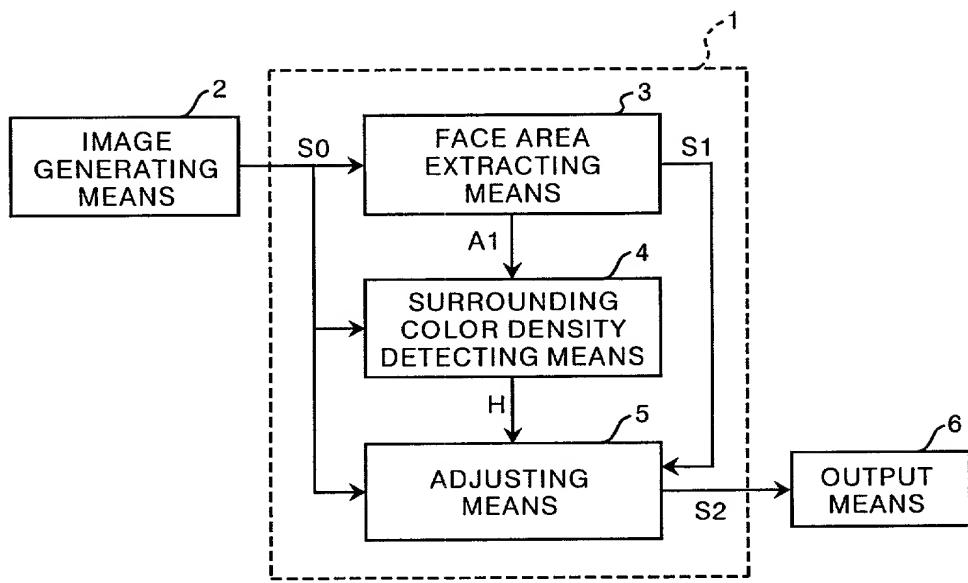
extracting a face area of the figure from the image; and  
adjusting density and/or color of the face area based on density information and/or color information of an area surrounding the face area.

ABSTRACT OF THE DISCLOSURE

A face area in an image including a figure is perceived to have appropriate color and/or density without being affected by color and/or density of an area surrounding the face area.

Face area extracting means extracts a face area from an image including a figure, and surrounding color density detecting means detects color density information indicating color and/or density (color density) of an area surrounding the face area. Adjusting means adjusts color density of the face area based on the color density information detected by the surrounding color density detecting means. By reproducing the image after the adjustment, the face area is perceived to have appropriate color density without being affected by the color density of the surrounding area.

# FIG. 1



# FIG. 2

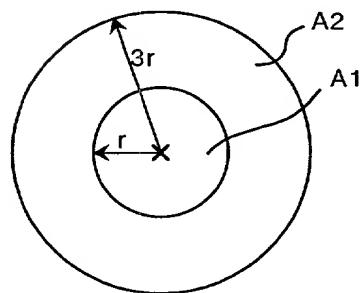


FIG.3

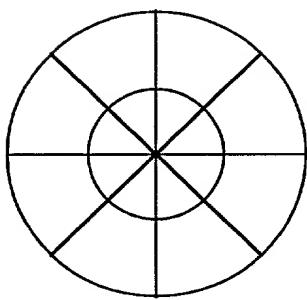
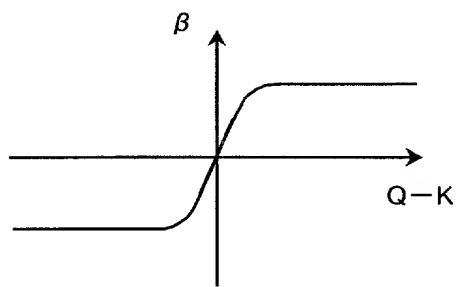
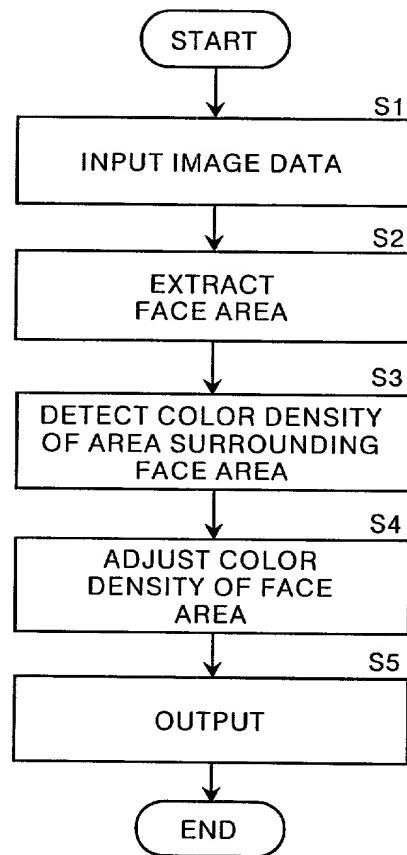


FIG.4



# FIG.5



**Declaration and Power of Attorney For Patent Application**

特許出願宣言書及び委任状

**Japanese Language Declaration**

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

Wataru Ito

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name. c/o Fuji Photo Film Co., Ltd., 798 Miyanodai, Kaisei-machi, Ashigarakami-gun, Kanagawa-ken, Japan  
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**"METHOD, APPARATUS AND RECORDING****MEDIUM FOR IMAGE PROCESSING"**

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国際出願番号を とし、  
(該当する場合) に訂正されました。

was filed on \_\_\_\_\_  
as United States Application Number or  
PCT International Application Number  
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\_\_\_\_\_ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

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**Prior Foreign Application(s)**

外国での先行出願 (patent) 41445/1999	Japan (Country) (国名)
(Number) (番号)	(Country) (国名)

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(Application No.) (出願番号)	(Filing Date) (出願日)
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Priority Not Claimed  
優先権主張なし

19/02/1999 (Day/Month/Year Filed) (出願年月日)	<input type="checkbox"/>
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(Status: Patented, Pending, Abandoned) (現況: 特許許可済、係属中、放棄済)
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Japan

### 第二共同発明者

### Full name of second joint inventor, if any

### 第二共同発明者

### 日付

### Second inventor's signature

### Date

### 住所

### Residence

### 国籍

### Citizenship

### 私書箱

### Post Office Address

（第三以降の共同発明者についても同様に記載し、署名をすること）

(Supply similar information and signature for third and subsequent joint inventors.)